

**THE *PERLESTA PLACIDA* (HAGEN) COMPLEX (PLECOPTERA: PERLIDAE)
IN ILLINOIS, NEW STATE RECORDS, DISTRIBUTIONS, AND AN
IDENTIFICATION KEY**

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Abstract.—*Perlesta placida* (Hagen), a complex of perlid stoneflies in eastern and central North America, currently includes 17 described species. Large collections of this genus exist at the Illinois Natural History Survey, and, as part of an effort to update the status of stoneflies in Illinois, all adult Illinois specimens were reexamined. *Perlesta decipiens* (Walsh) and *P. golconda* DeWalt and Stark were previously recorded from Illinois, and, with the addition of six new state records, the total number of *Perlesta* known from Illinois is now eight. The latter include *P. cinctipes* (Banks), *P. nr. teaysia* Kirchner and Kondratieff, *P. lagoi* Stark, *P. nelsoni* Stark, *P. shubuta* Stark, and *P. xube* Stark and Rhodes. For all species but *P. cinctipes*, ranges are greatly increased from either the southeastern states or the north-central Plains region. Other midwestern states are likely to harbor a speciose assemblage of *Perlesta*. Distributions and associated ecological conditions suggested a wider range of pollution tolerance than is currently known from published literature. A key to males, females, and eggs is provided to aid with regional identification of *Perlesta*.

Key Words: Plecoptera, *Perlesta placida* complex, Illinois, distribution, key

During much of the 20th century, the genus *Perlesta* was considered to include a single, highly variable and widespread species, *Perlesta placida* (Hagen) (Frison 1935, 1942; Needham and Claassen 1925). Frison (1935) found that only the winter stoneflies, *Allocapnia vivipara* (Claassen) and *Taeniopteryx burksi* Ricker and Ross (the latter reported as *T. nivalis* Fitch by Frison) exceeded its abundance in Illinois. This abundance is true for much of eastern North America. More recently, *P. placida* has been considered a species complex. Stark (1989), in his revision for the Nearctic Region, reported 12 species. He added that his results were preliminary, and that several more species were expected from poorly collected regions. Since then, five

additional species have been described (Kondratieff and Baumann 1999, DeWalt et al. 1998, Kirchner and Kondratieff 1997, Stark and Rhodes 1997, Poulton and Stewart 1991).

Frison and his colleagues at the Illinois Natural History Survey (INHS) were prolific collectors of aquatic insects from Illinois and throughout North America, and nearly all of these specimens are deposited in the INHS insect collection. Illinois *Perlesta* have been well collected throughout the century, and adult *Perlesta* account for 418 of the 18,885 current Plecoptera records at the INHS. These records are accessible in a searchable format at www.inhs.uiuc.edu/cbd/EPT/index.html. Frison and others identified the majority of

these *Perlesta* specimens as *P. placida* because most collections predated Stark's (1989) revision. Currently, only two species are known from Illinois, *Perlesta decipiens* (Walsh) (Harris and Webb 1995) and *P. golconda* DeWalt and Stark (DeWalt et al. 1998). Recent advances in the systematic knowledge of this species complex permitted a more thorough evaluation of the Illinois fauna using both historical and recent collections. As a result, six additional species from Illinois are recorded here.

Our objective is to document the species of *Perlesta* in Illinois by examining existing INHS collections and new material recently collected from throughout the state. To facilitate identification of Illinois *Perlesta*, we provide a key to the males, females, and eggs.

MATERIALS AND METHODS

New adult material was collected by sweeping streamside vegetation, by rearing, and by ultra-violet light trapping. Aedeagi were extruded from males in the field or under magnification in the laboratory. The latter worked best and allowed adults time to harden their cuticle and adopt mature coloration before preservation. Using Stark's (1989) protocol, the last 4–5 abdominal segments of both sexes were cleared in order to reveal internal and external genitalic characters.

Latitude and longitude coordinates for each unique location were determined using a DeLorme Street Atlas USA[®], version 4.0. Many records had vague localities, the exact locations of which were impossible to obtain. So as not to lose any location data, locations were coded with one of four levels of accuracy (Table 1). The four levels of accuracy were denoted on range maps with different sized symbols, usually with closed and open circles of increasing size. Collection locations were stored in electronic format using FileMaker Pro[®] software. Cartographic display of these locations was produced using Environmental Systems Research Institute's ArcView[®]

Table 1. Spatial accuracy codes used to distinguish accuracy of location information for *Perlesta* localities in Illinois.

Spatial Accuracy Code	Location Description from Labels
1	Known exact location.
2	Small municipality (<50,000 population) or park, point usually placed at center of town or at waterfront if stream name included on label.
3	Land survey data (principal meridian, township, range, section) or large municipality (>50,000), taken as center of municipality or section.
4	County, plotted as center of county.

software. ArcView connected across the INHS's computer network to the collection location database via FileMaker's Open Database Connectivity driver.

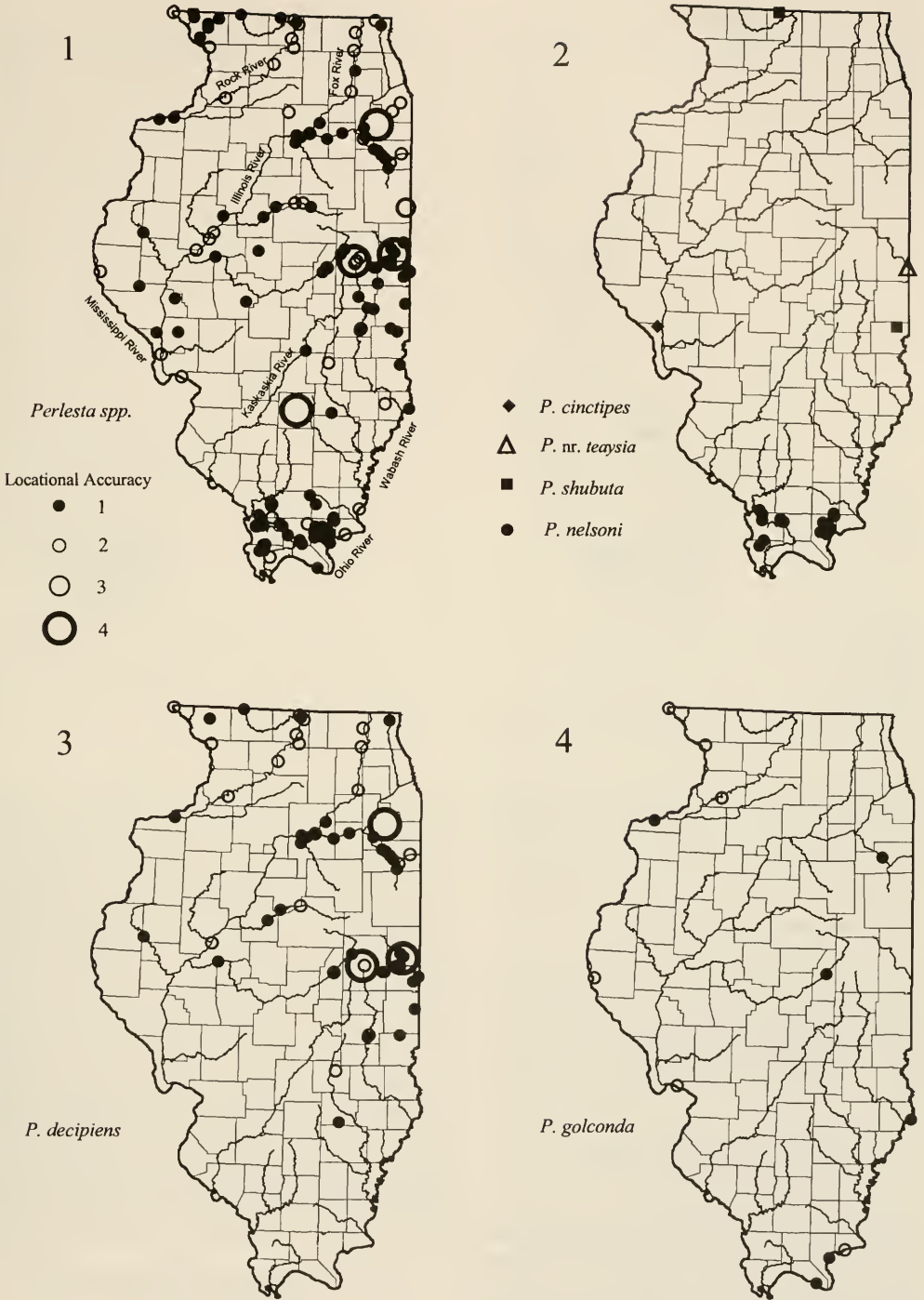
Traditionally, locality information has been provided in the text of works such as these. We have opted to rely on the Plecoptera database web site (see introduction for URL) for dissemination of this detailed and highly repetitive information. Those who do not have access to the Internet may request the information from the authors as a text file.

RESULTS AND DISCUSSION

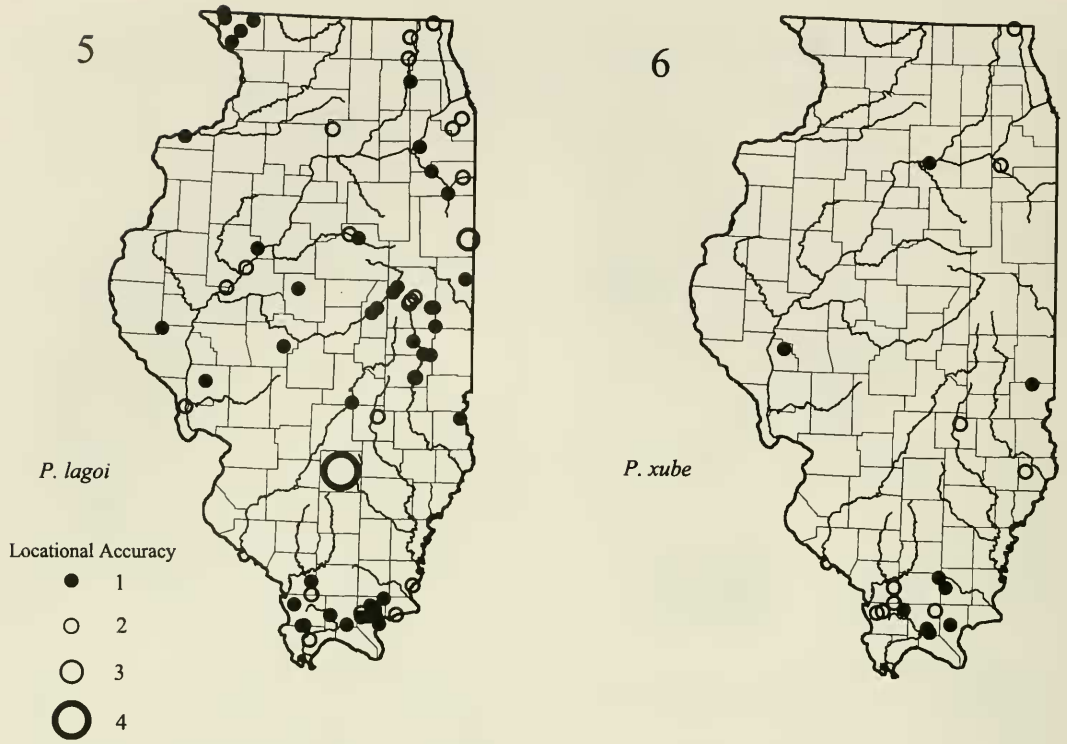
A total of 3,475 adult *Perlesta* specimens were identified from 151 unique locations across Illinois (Fig. 1). Eight of the 17 described *Perlesta* species were found, six of which are new state records. The Illinois distribution, general ecological requirements, and additional information on taxonomic characters are provided for each species encountered. Despite the large latitudinal gradient, the majority of records indicated a mid-June through late July emergence for all species encountered.

Perlesta cinctipes (Banks) (Figs. 2, 7, 15)

A single female of this species, a new state record, was taken from a small, rocky stream draining limestone bluffs near the



Figs. 1-4. *Perlesta* collection locations in Illinois. 1, All *Perlesta* collections. 2, *P. cinctipes* (diamond), *P. nr. teaysia* (triangle), *P. shubuta* (squares), *P. nelsoni* (circles). 3, *P. decipiens*. 4, *P. golconda*.



Figs. 5–6. *Perlesta* collection locations in Illinois. 5, *P. lagoi*. 6, *P. xube*.

confluence of the Illinois and Mississippi rivers (Fig. 2). Stark (1989) reported it from regions north and west of the Ozark Mountains, where it was collected most frequently from streams of lesser gradient (Poulton and Stewart 1991). Poulton and Stewart (1991) suggested that it could withstand moderate levels of organic enrichment. No detailed life history information was available for this species (Stewart and Stark 1988).

Perlesta decipiens (Walsh)
(Figs. 3, 8, 16)

Perlesta decipiens occurs throughout the northern two-thirds of the state (Fig. 3) and accounted for 48.8% of the records and 47.0% of all adult *Perlesta* specimens examined. Larger rivers were its principal habitat (DeWalt et al. 1999), where it accounted for well over 99% of all *Perlesta* specimens collected. It was also abundant

in all but the smallest streams in the Vermilion River basin of eastern Illinois.

This is the most widespread of all *Perlesta* species. Its distribution spans the Midwest, east to Pennsylvania, south to Texas, and west to the foothills of Colorado and eastern Wyoming (Stark 1989, Poulton and Stewart 1991). Snellen and Stewart (1979) reported a univoltine-fast life cycle with a lengthy egg diapause. This feature enables the species to inhabit intermittent streams and those with summer low oxygen and high water temperatures. Currently, *P. decipiens* is the only *Perlesta* species with a published life history.

Perlesta nr. *teaysia* Kirchner and
Kondratieff
(Figs. 2, 9, 17)

One collection consisting of two males and 10 females was taken from a small bluff stream that drained into the Vermilion

River (Fig. 2). This collection represents a new state record. The aedeagi were still inverted in the two male specimens, but by pulling on the loose ventral extension and unrolling (inside out) the whole structure we were able to discern that the aedeagus was long, thin, and lacked a caecum. These male specimens also had the tenth tergum with two elevated areas with stout sensilla basiconica, and the females had eggs with sessile collars. This description fits well with *P. teaysia*, except that *P. teaysia* has eggs with a short, wide collar (Kirchner and Kondratieff 1997). *Perlesta frisoni* Banks is a similar species, but our specimens lacked the median paraproct spine and the V-shaped subgenital plate notch (U-shaped in our specimens) as described by Stark (1989). It is possible that these specimens actually represent a new species, but without additional, properly prepared male specimens, we feel inclined to identify them as near *P. teaysia*. No detailed life history information is available for this species.

Perlesta golconda DeWalt and Stark
(Figs. 4, 10, 18)

This species was recently described by DeWalt et al. (1998) from the Ohio River in southern Illinois. It was also taken from scattered locations near large rivers, and a single specimen was collected from a relatively small reach of the Sangamon River (Fig. 4). This species has also been found in mature, meandering rivers in Nebraska (Nance County, Cedar River, NE hwy 14, N Fullerton, 26 June 1998, 8 males and 8 females; Valley County, Middle Loup River, NE hwy 70, 25 June 1998, 4 males and 2 females) (B. Kondratieff, personal communication). No life history information is available for this species.

Perlesta lagoi Stark
(Figs. 5, 11, 19)

This species represents a new state record and was the second-most abundant *Perlesta* species taken in Illinois. It contributed 32.8% of all *Perlesta* records and 44.8% of

the specimens. *Perlesta lagoi* was common throughout most of Illinois (Fig. 5). One major exception was in the Vermilion River basin of eastern Illinois, where only 26 specimens were taken. In contrast, *P. decipiens* contributed 1,106 specimens across all stream sizes in the basin. *Perlesta lagoi* was the dominant species in small streams throughout the rest of the state, even in slowly flowing streams. The only other published records for this species are for central and northern Mississippi (Stark 1989). No life history studies have been published for this species.

Perlesta lagoi is likely widespread throughout the Midwest and has almost certainly been confused with *P. decipiens* throughout the region. It has a somewhat spatulate paraproct, with a short, medially pointing spur. The spur of *P. decipiens* is larger and usually pointed directly ventrad. As Stark (1989) noted, the spur and rounded tip of the paraproct give the appearance of a "bird head and beak" in lateral aspect. Eggs of *P. lagoi* have no collar, while those of *P. decipiens* have a wide and stout collar. Subgenital plates were truncate in both species, but the notch was V-shaped in *P. lagoi*, while distinctly U-shaped in Illinois *P. decipiens*.

Perlesta nelsoni Stark
(Figs. 2, 12, 20)

Ten percent of the Illinois *Perlesta* records and 4.6% of the specimens were of *P. nelsoni*. All collections were from the Shawnee Hills and Ozark Uplands of southern Illinois (Fig. 2). Streams in the area contained sandstone or limestone substrates and many dried to pools in the summer. This species was previously known only from North and South Carolina and Tennessee (Stark 1989); hence, its presence in Illinois represents a sizable range extension and a new state record. All collections of this species were dated 1977 or later. Immigration, probably from the neighboring Kentucky highlands, is likely to have occurred within the last three decades. Pres-

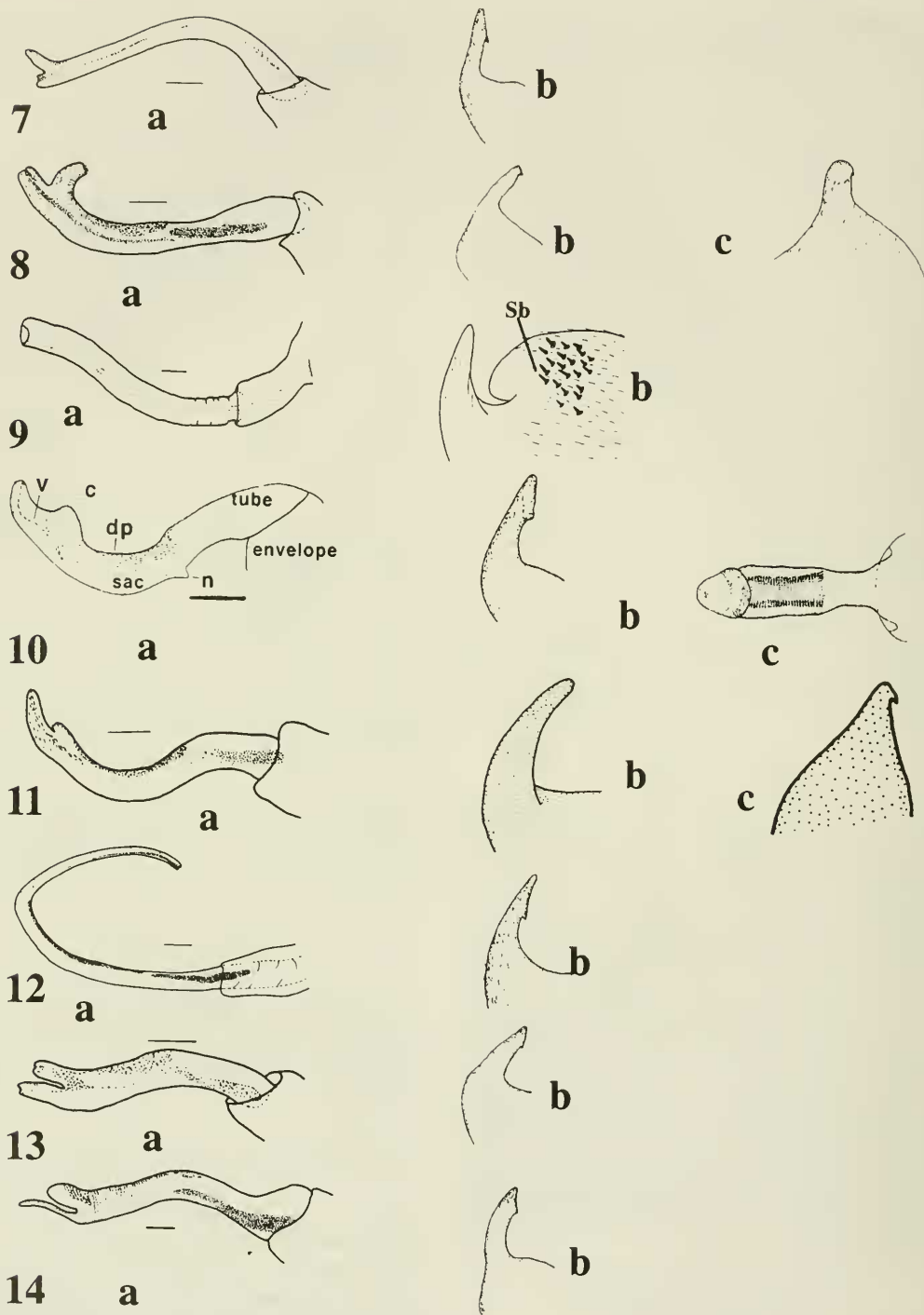


Fig. 7-14. Male structures of Illinois *Perlesta*. 7, *P. cinctipes* (a) lateral aedeagus; (b) lateral paraproct and spine. 8, *P. decipiens* (a) lateral aedeagus; (b) lateral paraproct; (c) caudal paraproct. 9, *P. nr. teaysia* (a) lateral aedeagus; (b) lateral tenth tergite and paraproct. 10, *P. golconda* (a) lateral aedeagus; (b) lateral paraproct; (c) dorsal aedeagus. 11, *P. lagoi* (a) lateral aedeagus; (b) lateral paraproct; (c) caudal paraproct. 12, *P. nelsoni* (a) lateral aedeagus; (b) lateral paraproct. 13, *P. shubuta* (a) lateral aedeagus; (b) lateral paraproct. 14, *P. xube* (a)

ently, no life history information is available for this species.

Perlesta shubuta Stark
(Figs. 2, 13, 21)

Two records, accounting for 17 specimens, came from near the Wisconsin border and along the southeastern Indiana border (Fig. 2). These specimens represent a new state record and a considerable range extension. Previous records include Arkansas, Missouri, Mississippi, and Oklahoma (Poulton and Stewart 1991, Stark 1989). Poulton and Stewart (1991) stated that this species was relegated to larger, permanent streams, and it was the only *Perlesta* limited to these conditions in their study area. Illinois records were from streams that fit this description.

Perlesta xube Stark and Rhodes
(Figs. 6, 14, 22)

Five percent of the records and 1.5% of the specimens were *P. xube*. All specimens were taken from small, wooded streams that shrank to pools in the summer, but were seldom completely dry (Fig. 6). *Perlesta xube* was described from Nebraska (Stark and Rhodes 1997) and also has been reported from North Dakota (Kondratieff and Baumann 1999). Its existence in Illinois is a new state record and a sizable range extension. No life history studies have been conducted on *P. xube*. This species may be confused with *P. adena* (Stark), but *P. xube* is distinguished by its long and sinuous aedeagal tube and the presence of a long dorsal hair patch running the length of the tube to the large caecum. *Perlesta adena* has a short, plump aedeagus without a long dorsal patch (Stark 1989). The following characteristics of forewing coloration define *P.*

xube (Stark and Rhodes 1997): a light middle third of the costal margin, a white patch before the arculus, a white streak along the medial vein, and a light streak in the intercubital area, all on a charcoal colored background. Alternatively, the costal margin of *P. adena* is pale along its entire length, and no other light wing markings are known for this species.

DISCUSSION

The INHS has a long history of documenting the aquatic insect community of the state. The large natural history collection permitted us to re-evaluate a challenging species complex. We have added six new state records for Illinois within this genus alone. These additions increased the number of Illinois stoneflies from 64 (DeWalt et al. 1998, Harris and Webb 1995) to 70. The speciose nature of the *P. placida* complex will likely hold for other midwest states whose geographic and glacial history is similar to that of Illinois. Additionally, we expect that other perlid complexes, especially *Neoperla*, will yield additions to the state's fauna.

Frison's (1935) treatment of *Perlesta* as a single species led Hilsenhoff (1987) to provide one environmental tolerance value for *Perlesta*. Lenat (1993), after Stark's (1989) revision, indicated major differences in environmental tolerance between the relatively tolerant *P. placida* and other more sensitive regional *Perlesta* species. In finding a diverse *Perlesta* fauna in Illinois, and demonstrating apparently different ecological occurrences, the assignment of one tolerance value for the entire genus is inappropriate. To date, the only detailed life history study available is for *P. decipiens* (Snellen and Stewart 1979). Additional life

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lateral aedeagus; (b) lateral paraproct. Figs. 7a–9a, 11a, and 12a–13b borrowed or modified, with permission, from Stark (1989). Figs. 14a and 14b borrowed or modified, with permission, from Stark and Rhodes (1997). Abbreviations: c = caecum; dp = dorsal patch; n = nipple; v = ventral extension; Sb = sensilla basiconica. Scale for aedeagi only, 0.15 mm.

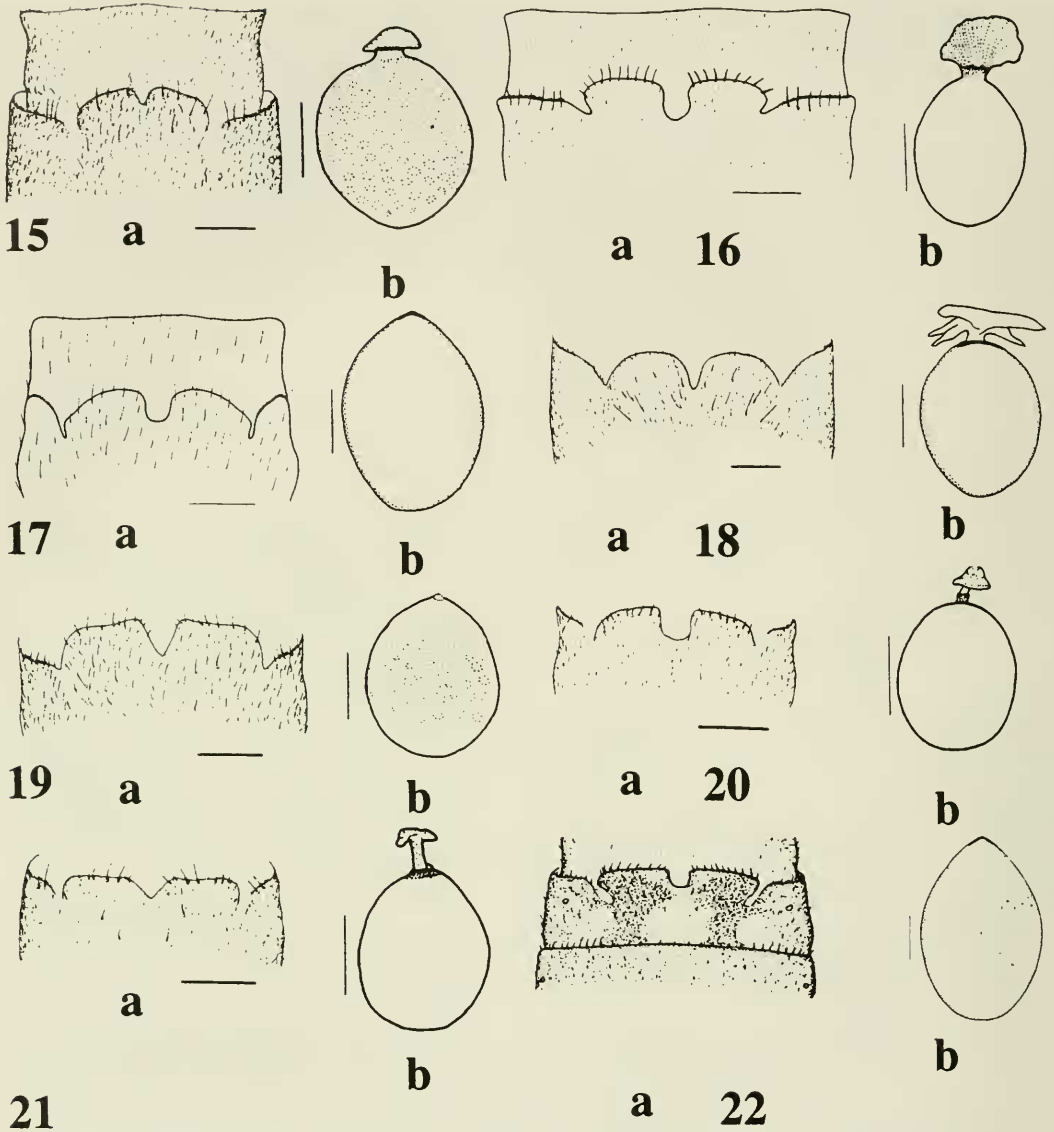


Fig. 15–22. Subgenital plate (a) and egg (b) of Illinois *Perlesta* females. 15, *P. cinctipes*. 16, *P. decipiens*. 17, *P. nr. teaysia*. 18, *P. golconda*. 19, *P. lagoi*. 20, *P. nelsoni*. 21, *P. shubuta*. 22, *P. xube*. Figs. 15a and 15b, 16b, 17b, 19a–21b borrowed or redrawn, with permission, from Stark (1989). Fig. 22a and 22b borrowed or redrawn, with permission, from Stark and Rhodes (1997). Scales for subgenital plates, 0.30 mm, for eggs 0.15 mm.

history studies and the association of nymphs with adults would help calibrate tolerance values for species in the genus.

A KEY TO MALES, FEMALES, AND EGGS OF THE *PERLESTA* OF ILLINOIS

- 1. Head, body, wing, veins, and wing membranes very pale; aedeagal tube with poorly developed

caccum (Fig. 10a), dorsal patch broad, with larger lateral setae forming distinct parallel lines (Fig. 10c); subgenital plate lobes rounded (Fig. 18a), notch V-shaped; egg collar sessile, chorion smooth, to slightly granular (Fig. 18b)

- *P. golconda*
- Head and body with areas of pigmentation, wing veins pale to black, wing membrane ranging from pale to black; aedeagus with or with-

- out caecum; subgenital plate lobes truncate or rounded, notch U- or V-shaped; egg collar sessile or stalked, chorion smooth or pitted 2
- 2. Body and wing coloration generally light; males with one or more well-defined patches of sensilla basiconica on tenth tergite (Fig. 9b), aedeagus long, sinuate, lacking caecum (Figs. 9a, 12a) 3
- Body and wing with areas of pigmentation ranging from amber to black; males without well-defined patch of sensilla basiconica, although a few scattered single sensilla may be present; aedeagus short or long, but with a caecum (Figs. 7a, 8a, 11a, 13a, 14a) 4
- 3. Sensilla basiconica in two elevated, circular patches on tenth tergite, paraproct tip pointed and well-sclerotized, without median spine (Fig. 9b); subgenital plate lobes rounded, notch U-shaped (17a); egg chorion with mesal band of inconspicuous shallow pits, collar sessile (Fig. 17b) *P. nr. teaysia*
- Sensilla basiconica in one low, sparse patch; paraproct tip rounded, lightly sclerotized, with median spine well-removed from tip (Fig. 12b); subgenital plate lobes truncate, notch U-shaped (Fig. 20a); egg chorion smooth, collar short and slender *P. nelsoni*
- 4. Body and wing coloration dark brown to black 5
- Wing coloration amber; body with light brown reticulations on yellowish background 6
- 5. Wings with costal area pale throughout, but no other light markings; aedeagus and caecum long and slender, dorsal patch short, not well-developed laterally (Fig. 7a), paraproct spine directed ventrad (Fig. 7b); subgenital plate lobes rounded, notch shallow and V-shaped (Fig. 15a); egg chorion coarsely pitted throughout, collar stalked (Fig. 15b) *P. cinctipes*
- Wings with only middle 1/3 to 1/2 of costal margin light, light area before arculus, light streaks above medial vein and in intercubital area; aedeagus and caecum robust, dorsal patch occupying most of tube length and extending laterally in a wide band on caecum (Fig. 14a), paraproct spine directed medially (Fig. 14b); subgenital plate notch deep, U-shaped (Fig. 22a); egg chorion finely punctate in middle 2/3, collar sessile (Fig. 22b) *P. xube*
- 6. Paraproct rounded or pointed, spine prominent in lateral view and directed ventrally (Fig. 8b, 13b); aedeagus with caecum about two times longer than wide (Fig. 8a, 13a); subgenital plate U- or V-shaped; egg chorion smooth, collar stalked (Fig. 16b, 21b) 7
- Paraproct spatulate, spine not prominent in lateral view and directed mesally, (Fig. 11b) the latter best seen in caudal view (Fig. 11c); ae-

- deagus with caecum only as long as wide (Fig. 11a); subgenital plate notch V-shaped (Fig. 19a); egg chorion shallowly pitted in middle 2/3, collar sessile (Fig. 19b) *P. lagoi*
- 7. Paraproct pointed, face angular (about 45°), spine rotated somewhat medially (Fig. 13b); subgenital plate notch V-shaped (Fig. 21a); egg collar occupying only 1/4 to 1/3 width of pole, anchor pedicel a single thick stalk (Fig. 21b) *P. shubuta*
- Paraproct rounded, face rounded, spine usually pointed ventrad (Fig. 8b and 8c); subgenital plate notch U-shaped (Fig. 16a); egg collar occupying at least 1/2 width of pole, anchor pedicel composed of many filaments (Fig. 16b) *P. decipiens*

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